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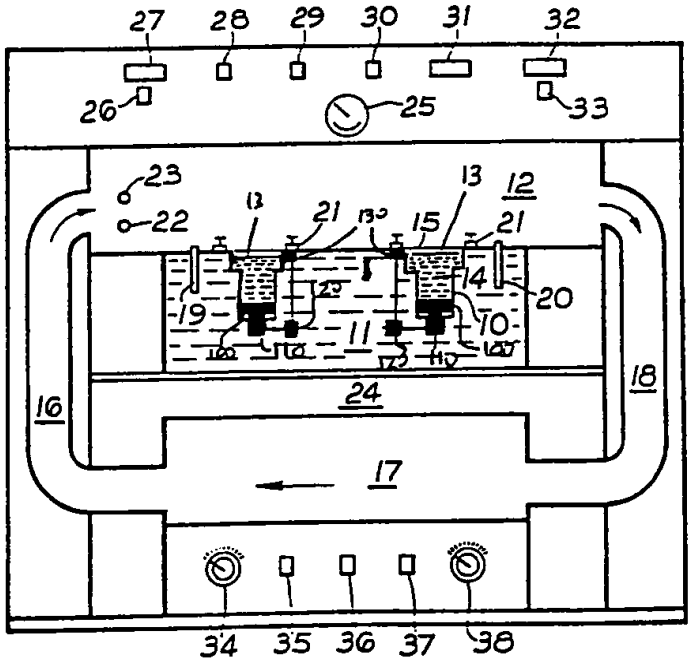
(54) Vapour transmission test apparatus

(57) Vapour transmission testing apparatus comprising a test chamber 10 adapted to receive a liquid, securing means 21 adapted to secure to said test chamber a sheet material 15 to be tested, said securing means being adapted to secure said material to said test chamber above the surface 13 of said liquid, and volume measuring means to measure the change in volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined. The volume measuring means comprises a piston 100 in the bottom of chamber 10 which is raised by a stepper motor 100 which is pulsed by a linear activator 120 under the control of a water level sensor, 130, e.g. a floatswitch, photo electric device or electrical probes, to maintain the water level constant. The distance travelled by the piston is a measure of the volume of liquid transmitted through sheet 15. A conductivity measuring means measuring the change in concentration of the liquid in chamber 10 may be additionally provided. Above test chamber 10 is a plenum chamber 12 supplied with air from an air conditioning unit.



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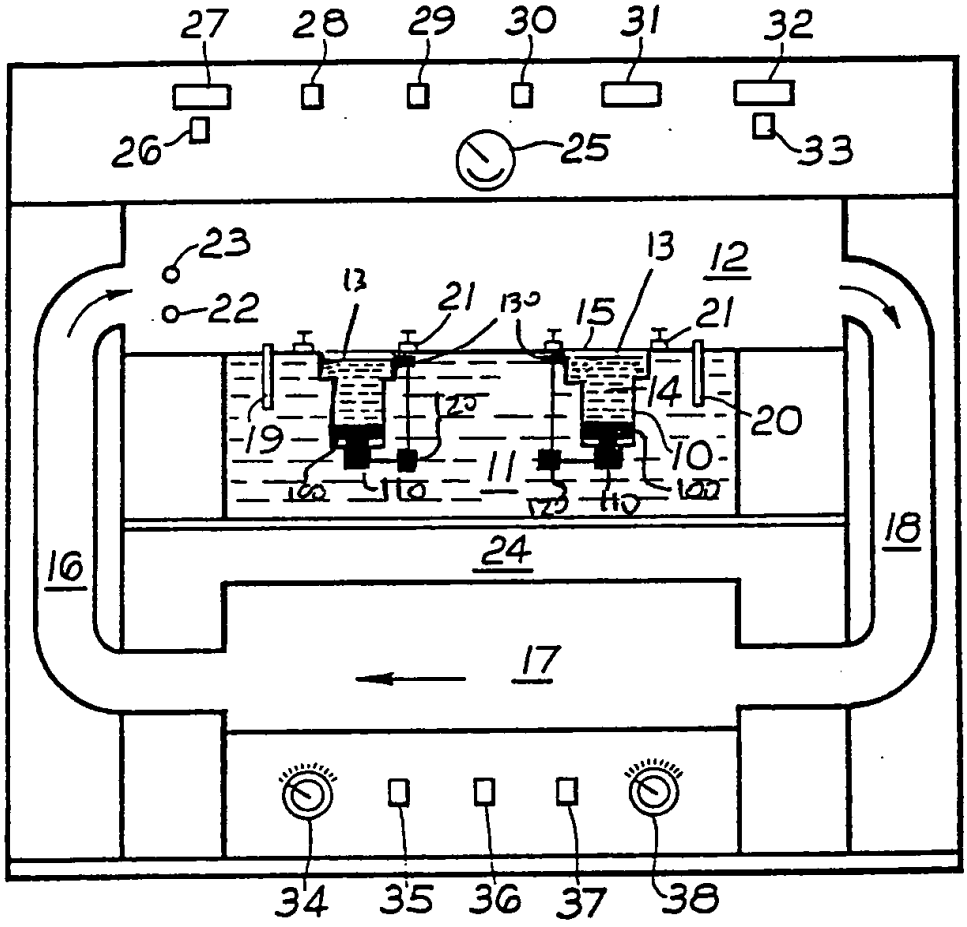
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VAPOUR TRANSMISSION TESTING APPARATUS

This invention relates to a method and apparatus for testing vapour transmission through materials, for example textile fabrics and the like.

One example of a material whose water vapour transmission it may be desirable to measure is garment fabric. Rainproof garments may be made from textile fabrics coated with a layer of proofing material such as a plastics material. With suitable sealing at the seams, for example by welding, these garments can be made completely rainproof. A problem which is experienced, however, is that perspiration cannot escape and this leads to a build-up of moisture inside the garment, particularly when the wearer is engaged in strenuous exercise. Various proposals have been made for improving the vapour transmissibility of the fabric while retaining its rainproof characteristics, but there is a need to measure accurately the rate at which vapour is transmitted through the fabric so that comparisons may be made between different types of fabric.

Attempts have been made to measure water vapour transmission by using the change in weight of dessicants in a container closed by a sample of the fabric, whose other face is exposed to a humid atmosphere, eg in a heated chamber containing water. It is desirable to measure vapour transmission over a long period, for example 24 hours, to give a vapour transmission measurement which can be readily related to use of the fabric in a garment. However, water absorption by dessicants gives rise to localised saturation which reduces the efficiency of water absorption, and so over a 24 hour period, the rate of water absorption will vary considerably. Thus, any measurement of water vapour transmission through the fabric will be inaccurate, and the inaccuracy is magnified when the rate is expressed in terms of a square metre of the fabric. Additionally, a dessicant will need to be removed from the test apparatus for weighing, and during weighing, both initially and finally, it may be subjected to an environment having a different moisture content, which can affect the accuracy of the weighing. In addition, weighing small samples of dessicant accurately is difficult and the change in weight over a 24 hour period may be relatively small, with the result that the water vapour transmission figure derived is even less accurate. Finally, a variation of initial conditions inside the chamber containing the dessicant will again affect the

accuracy of the figure obtained.

An object of the present invention is to provide improved testing apparatus and method for determining the vapour transmission characteristics of a sheet material.

In our European patent application No. 0172725 there is disclosed apparatus for testing the vapour transmission characteristics by measuring the change in concentration of a solution in a test chamber. It has now been found that the vapour transmission characteristics of a material can be determined by measuring the change in other variables of the liquid in the test chamber. An example of one such other variable which can be measured is the change in volume of the liquid in the test chamber.

According to one aspect of this invention there is provided vapour transmission testing apparatus comprising a test chamber adapted to receive a liquid, securing means adapted to secure to said test chamber a sheet material to be tested, said securing means being adapted to secure said material to said test chamber above the surface of said liquid, and volume measuring means to measure the change in

volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined.

The volume measuring means may comprise a movable wall of said chamber, said movable wall being driven by drive means.

In one embodiment of the invention, the volume measuring means comprises sensing means adapted to sense the level of the surface of the liquid, said sensing means being in communication with said drive means to cause said movable wall to maintain the surface of the liquid at a substantially constant level. Thus, the distance between the surface of the liquid and the sheet material is maintained substantially constant.

The drive means may comprise stepwise drive means adapted to move said movable wall in steps.

Preferably the drive means comprises a stepper motor connected to a linear activator, said stepper motor being adapted to move said movable wall in steps in response to impulses from said linear activator. The stepper motor may be connected to the linear activator by suitable gearing.

According to another aspect of this invention there is provided vapour transmission testing apparatus comprising an open topped test chamber to receive a liquid, securing means to secure a sheet material to be tested adjacent the open top of said test chamber, a plenum chamber above said test chamber, heating means to maintain the test chamber at a desired temperature, and volume measuring means to measure the change in volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined.

Preferably, the volume measuring means is as described above.

According to a further aspect of this invention there is provided a method of testing the vapour transmission characteristics of a sheet material, said method comprising disposing a sheet material to be tested above a liquid in a test chamber maintaining the surface of the liquid substantially constant and measuring the chamber in volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined.

Preferably, the method further comprises sensing the level of the surface of the liquid and maintaining said level substantially constant by stepwise moving of a movable wall of said test chamber. Thus the distance between the surface of the liquid and the sheet material is maintained substantially constant.

This invention is particularly suitable for testing the water vapour transmission characteristics of garment fabrics such as textile and non-textile fabrics, both with and without proofing coatings, films and foils.

Where garment fabrics are to be tested, the liquid can be an aqueous solution and can be a saline solution. The liquid can be maintained at approximately body temperature so as to closely simulate human perspiration.

It is envisaged that standardised test conditions could be defined to give a comparative water vapour transmission rating for fabrics.

Reference is now made to the drawing, which shows diagrammatically an apparatus in accordance with the invention.

The apparatus comprises a cabinet which incorporates heating means which, in the embodiment shown, is a heating chamber in the form of a water bath 11. The temperature in the bath 11 is controlled by a thermostat 19 associated with a temperature probe 20.

The test chambers 10 are provided, each being adapted to receive an aqueous solution and having a movable wall in the form of a piston 100. Each piston 100 is connected to drive means in the form of a stepper motor (shown schematically at 110) geared to a linear activator (shown schematically at 120). Sensing means 130 in communication with the linear activator 120 is also provided to sense the level 13 of the aqueous solution in each of the test chambers 10.

Each linear activator 120 is connected via suitable electric circuitry to digital read outs 27 and 32 respectively, each read out being associated with its respective on/off switch 26 and 33.

Each test chamber 10 is provided with securing means in the form of clamping rings 21 which enable a test disc 15 of a sheet material to be clamped over the mouth of the test chamber.

Above the test chambers on the opposite side of the test discs when in position there is provided a plenum chamber 12 supplied with air from an air conditioning unit 17 by any of one or more ducts 16, the air being returned to the conditioning unit by way of one or more ducts 18.

The air conditioning unit is provided with conventional elements (not shown) for controlling temperature and humidity of the air. The conditioning unit control panel includes temperature and humidity setting indicators 34 and 38 respectively and on/off switches for controlling heat (35) refrigeration (36) and humidity (37).

The control panel for the heating tank comprises an on/off mains switch 28, tank boost heat on/off switch 29, tank heat on/off switch 30 and a tank temperature digital readout 31. The cabinet temperature and humidity are shown on indicator 25.

In use, the apparatus is calibrated using solutions of known concentration in the test chamber, and then the standard test solution is introduced. Under standard test conditions, the starting solution will be specified. A sample of the fabric to be tested is clamped to the open top of the test chamber by the clamping ring 21, the conditions

in the plenum chamber 12 adjusted to simulate a specified environment and the temperature of the solution allowed to reach the temperature of the water tank.

As the water evaporates from each test chamber 10, the water level 13 in the test chamber 10 will fall. This fall in water level will be sensed by the sensing means 130 and will cause the linear activator 120 to transmit fine impulses to the stepper motor 110. The stepper motor 110 will then cause the piston 100 to move upwards in small steps thereby maintaining the level 13 substantially constant.

The distance which the stepper motor causes the piston 100 to move upwards is an indication of the volume of liquid evaporated and this volume is displayed as a digital readout on the read outs 27 and 32.

By suitable arrangement of linear activator 120 and stepper motor 110 an accuracy of about 0.01% can be achieved.

Using the apparatus and method of the invention, accurate comparisons may be made of the water vapour transmission of materials such as fabrics under a wide range

of conditions, thus assisting not only in the development of improved fabrics, but also providing a standard to enable potential purchases to assess the comfort of the garment from a quoted test figure. In addition to fabrics for garments, fabrics for use in applications such as sleeping bags and tents may also be tested. Further, the apparatus and method of the invention may be used in the measurement of water vapour transmission through a wide range of materials other than fabrics, for example, electrical installation materials, damp-proof membranes for building purposes, and paints and varnishes. The invention is particularly applicable to measurement of water vapour transmission through relatively thin materials.

The sensing means 130 can be any suitable means, for example a float operated electrical level switch, or a photoelectric device and the output from the device utilized to control the level adjusting means. Preferred sensing means comprises electrical probes.

It has been found that surface tension effects can influence detection of the surface by an electrical probe and to overcome this problem the piston may be lowered

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periodically to break the meniscus and then restored to its position. This enables a more accurate output to be obtained.

It is possible also to use conductivity measuring means in the form of a saline probe (not shown) to measure the rate of change of concentration of the solution. This would be used as a back-up to the measurement of the rate of change of the volume of the solution.

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CLAIMS

1. Vapour transmission testing apparatus comprising a test chamber adapted to receive a liquid, securing means adapted to secure to said test chamber a sheet material to be tested, said securing means being adapted to secure said material to said test chamber above the surface of said liquid, and volume measuring means to measure the change in volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined.

2. Apparatus according to Claim 1 wherein the volume measuring means comprises a movable wall of said chamber, said movable wall being driven by drive means.

3. Apparatus according to Claim 2 wherein the volume measuring means comprises sensing means adapted to sense the level of the surface liquid, said sensing means being in communication with said drive means to cause said movable wall to maintain the surface of the liquid at a substantially constant level.

4. Apparatus according to Claim 2 or 3 wherein the drive means comprises stepwise drive means adapted to move said movable wall in steps.

5. Apparatus according to any of Claims 2 to 4 wherein the drive means comprises a stepper motor connected to a linear activator, said stepper motor being adapted to move said movable wall in steps in response to impulses from said linear activator.

6. Vapour transmission testing apparatus comprising an open topped test chamber to receive a liquid, securing means to secure a sheet material to be tested adjacent the open top of said test chamber, a plenum chamber above said test chamber, heating means to maintain the test chamber at a desired temperature, and volume measuring means to measure the change in volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined.

7. A method of testing the vapour transmission characteristics of a sheet material to be tested above a liquid in a test chamber maintaining the surface of the liquid substantially constant and measuring the change in

volume of the liquid as the liquid evaporates, whereby the vapour transmission characteristics of the sheet material can be determined.

8. A method according to Claim 7 further comprising sensing the level of the surface of the liquid and maintaining said level substantially constant by stepwise moving of a movable wall of said test chamber.

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